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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application] This invention relates to the liquid crystal panel which used the reflector, and its manufacture approach.
[0002]
[Description of the Prior Art] In recent years, the display using the liquid crystal display object which has the descriptions, such as a light weight and a thin shape, as an image display device is in the limelight. Using for this display the high brightness liquid crystal panel which used the polymer dispersed liquid crystal is known, for example, it is indicated by JP,5-313157,A.
[0003] Hereafter, the conventional high brightness panel is explained. Drawing 2 is the sectional view of the conventional-type liquid crystal panel which used the polymer dispersed liquid crystal. However, the part unnecessary for explanation is omitted. The polymer dispersed liquid crystal 12 is ****(ed) between the counterelectrodes 11 and reflectors 13 of light transmission nature. The thin film transistor 17 and the pixel electrode 16 which were formed on the reflector 13 and the array substrate 18 are electrically connected through the connection hole 14 embedded by the conductive matter prepared in the insulating layer 15. If an electrical potential difference is impressed to a polymer dispersed liquid crystal 12 with this counterelectrode 11 and reflector 13, since a polymer dispersed liquid crystal 12 will become light transmission nature, it is reflected with a reflector 13 and outgoing radiation of the light which carried out incidence through the counterelectrode 11 is carried out from a counterelectrode 11 as it is. On the other hand, since a polymer dispersed liquid crystal 12 shows light-scattering nature when not impressing an electrical potential difference to a polymer dispersed liquid crystal 12, there is little quantity of light which reaches a reflector 13, and its quantity of light by which outgoing radiation is carried out from a counterelectrode 11 also decreases, and it functions as a pixel. That is, the brightness of a liquid crystal panel is decided by the quantity of light reflected from a reflector 13.
[0004] In order to gather the reflection factor of the perpendicular direction of a reflector 13, the aluminum use with a reflection factor high as flattening of the insulating layer 15 by the spreading insulator layer and an ingredient of a reflector 13 is tried. In addition, with aluminum, the other aluminium alloys of aluminum itself are also included on these specifications.
[0005]
[Problem(s) to be Solved by the Invention] The aluminum which is the reflector of the

above-mentioned conventional liquid crystal panel has a low reflection factor. There is a problem to which the brightness of the image of a liquid crystal panel falls as a result.
[0006] The purpose of this invention is to offer a reflector with a high reflection factor, and the liquid crystal panel using it.
[0007]
[Means for Solving the Problem] The above-mentioned purpose is attained by making a reflector into the two-layer structure which consists of the 1st metal membrane which raises the amount of preferred orientation of aluminum, and the 2nd metal membrane which consists of aluminum on said 1st metal membrane.
[0008] Moreover, the above-mentioned purpose makes an interface with the insulator layer under a reflector and a reflector the shape of toothing, and the die length of a crevice and heights is attained by considering as 1/10 or more [of the thickness of a reflector], and 3 or less times. Here, the thickness of a reflector means the thickness from the top face of a reflector to the crevice base of a reflector.
[0009]
[Function] When refractory metal film, such as titanium, was formed on the base, the aluminum film was formed on it and it was the two-layer structure, it turned out that a reflection factor becomes high. Here, the result of having measured the reflection factor after forming and heat-treating the aluminium alloy film on the titanium film to which thickness was changed is shown in drawing 3 R> 3. When 3nm or more of reflection factors of the aluminium alloy film had titanium thickness depending on the titanium thickness prepared in directly under, and the improvement effectiveness in a reflection factor of the aluminium alloy film was remarkable and became 1/4 to 1/5 or more of aluminium alloy thickness, it turned out that the effectiveness is saturated. In addition, when titanium thickness becomes 3 or more times of aluminum thickness, the reaction of titanium and aluminum progresses too much and a reflection factor has rather the inclination to fall. Moreover, although it may become the aluminium alloy film of the monolayer to which it dissolved completely [a titanium atom] in the aluminum film that titanium thickness was about [of aluminum thickness / 1/30 or less], and the titanium film disappeared and titanium dissolved by heat treatment after membrane formation, there is the improvement effectiveness in a reflection factor also in that time.
[0010] Thus, if the titanium film is formed directly under the aluminum film, it will be thought of with since it has the function the titanium film raises the amount of preferred orientation of the aluminum film that a reflection factor improves. If the amount of preferred orientation is high, surface relief will decrease and it will be thought that a reflection factor improves. On the other hand, with the structure of the reflector of the above-mentioned conventional technique, compared with the case where the titanium film is prepared, since the amount of preferred orientation is low, the aluminum film formed on the insulator layer is considered that a reflection factor is low.
[0011] Furthermore, the titanium atom of the titanium film segregates to the aluminum grain boundary, therefore it is hard coming to generate grooving of the aluminum grain boundary, and the dry area of the front face of the aluminium alloy film is stopped.
[0012] Moreover, although hundreds of degrees C heat treatment was usually repeated several times in the production process, even when it heat-treated, the aluminium alloy film formed on the titanium film was also understood that a hillock is hard to be formed.
[0013] Moreover, it is a non-theory to be unable to limit the electrode for light reflexes of

this invention to application to the liquid crystal panel which used the polymer dispersed liquid crystal, and for it to be able to apply to reflective mold liquid crystal panels, such as a twist NEMATEKKU liquid crystal panel.

[0014] When an interface with the insulator layer under a reflector and a reflector is made into the shape of toothing, and the die length of a crevice and heights considered as 1/10 or more [of the thickness of a reflector], and 3 or less times, for example the aluminium alloy film is used as a reflector on the other hand, from the contact surface with an insulator layer, the low-index sides (111) (field etc.) of aluminum double bearing, and grow, the amount of preferred orientation of the specific crystal face goes up, and a reflection factor improves. Moreover, since grooving of the grain boundary cannot break out easily even if it heat-treats, the dry area of the front face of the aluminium alloy film is stopped, and the liquid crystal panel of high brightness is obtained.

[0015] In addition, the matter of a counterelectrode with permeability high as much as possible is desirable to light to display.

[0016]

[Example]

It explains using drawing 4 below the <example 1>. On the silicon oxide film (19), the titanium film (131) of 200nm of thickness and the aluminum film (132) containing 1% of the weight of silicon of 800nm of thickness were formed by the well-known spatter (150 degrees C) one by one. Henceforth, the aluminum containing 1% of the weight of silicon is abbreviated to aluminum-Si. Thus, it was 87% when the reflection factor of the formed metal membrane was measured using the reflection factor measuring device (the light source is a source of the light) with the optical system of drawing 5 . Next, after performing heat treatment for [450 degrees-C] 20 minutes for this sample in an argon ambient atmosphere, when the reflection factor was again measured using the aforementioned reflection factor measuring device, that reflection factor became 82%. This is before heat treatment conventionally which does not prepare a titanium layer as compared with structure, about 5%, is after heat treatment and has about 10% of improvement effectiveness in a reflection factor.

[0017] Although titanium was used as a refractory metal in this example, otherwise, the effectiveness that refractory metals of the alloy which makes these a principal component, such as a zirconium, a hafnium, vanadium, niobium, a tantalum, chromium, molybdenum, a tungsten, a scandium, and an yttrium, were also equivalent was acquired. An alloy here cannot be overemphasized by that an amorphous alloy is included.

[0018] Since grooving in the grain boundary cannot break out easily so that the amount of preferred orientation of the aluminum-Si film is high, a reflection factor becomes high like the high film of the amount of preferred orientation. Then, when the sample of this example was measured with the X-ray diffraction method, orientation (111) of the aluminum-Si film was carried out, and the gap from the substrate side of a field (111) was less than 3 times in general. (111) The gap from the substrate side of a field is the half-value width of the rocking curve of a field (111). On the other hand, with the structure in which the direct aluminum-Si film was formed on the conventional amorphous insulator layer, the gap was 5 to 8 times.

[0019] <Example 2> drawing 1 is the production process sectional view of the projection mold liquid crystal panel which has the electrode of a high reflection factor of this invention. The part unnecessary to explanation is omitted. The thin film transistor 17 and

the pixel electrode 16 which are a switching element were formed on the array substrate 18 (drawing 1 (a)). next, the insulator layer 15 which has opening on a thin film transistor 17 and the pixel electrode 16 -- forming -- opening -- chemical vapor deposition (CVD) -- the tungsten was embedded by law and the connection hole 14 was formed (drawing 1 (b)). Furthermore, the reflector 13 which consists of a titanium metal membrane 131 and an aluminum reflective metal 132 was formed on the insulator layer 15. The projection mold liquid crystal panel consisted of forming the counterelectrode 11 of a polymer dispersed liquid crystal 12 and light transmission nature on this reflector 13 (drawing 1 (c)). Thus, compared with the conventional liquid crystal panel, improvement in brightness was found by making a reflector 13 into the substrate metal 131, the reflective metal 132, and two-layer structure.

[0020] Although the reflector was made into the two-layer structure which put aluminum film on the titanium film in this example, the alloy (an amorphous alloy is also included) and compound which make a principal component refractory metals, such as a zirconium, a hafnium, vanadium, niobium, a tantalum, chromium, molybdenum, a tungsten, a scandium, and an yttrium, or this instead of titanium may be used.

[0021] If a reflector 13 is furthermore constituted from a thin film (it is the three-layer thin film of aluminum-Si/Ti/TiN etc. from the upper layer) of three or more layers, it is also possible to suppress the reaction of a reflector 13 and the pixel electrode 16.

[0022] In this example, although the tungsten was embedded with the CVD method at opening, you may be not only a tungsten but molybdenum or these alloys etc. Furthermore, conductors, such as aluminum, may be formed in opening by not being based on a CVD method but combining the usual spatter and etching.

[0023] <Example 3> drawing 6 is the production process sectional view of the projection mold liquid crystal panel which has the electrode of a high reflection factor of this invention. The part unnecessary to explanation is omitted. First, the thin film transistor 17 and the pixel electrode 16 which are a switching element were formed on the array substrate 18 (drawing 6 (a)). Next, the insulator layer 15 which has opening was formed on the thin film transistor 17 and the pixel electrode 16, and the reflector 13 which consists of a titanium metal membrane 131 and an aluminum reflective metal 132 was formed on the insulator layer 15 from opening (drawing 6 (b)). The projection mold liquid crystal panel consisted of forming the counterelectrode 11 of a polymer dispersed liquid crystal 12 and light transmission nature on this reflector 13 (drawing 6 (c)). Thus, compared with the conventional liquid crystal panel, improvement in brightness was found by making a reflector 13 into the substrate metal 131, the reflective metal 132, and two-layer structure.

[0024] Like this example, a reflector 13 is directly contacted to the pixel electrode 16, and a production process becomes easier as compared with **** and the approach of the above-mentioned example 2.

[0025] <Example 4> drawing 7 is the production process sectional view of the projection mold liquid crystal panel which has the electrode of a high reflection factor of this invention. The part unnecessary to explanation is omitted. First, the thin film transistor 17 and the pixel electrode 16 which are a switching element were formed on the array substrate 18 (drawing 7 (a)). Next, the reflector 13 was formed by forming the insulator layer 15 which has opening on a thin film transistor 17 and the pixel electrode 16, forming the tungsten metal membrane 133 using a CVD method so that opening may be

embedded on an insulator layer 15 from opening, and forming the titanium metal membrane 131 and the aluminum reflective metal 132 on the tungsten metal membrane 133 further (drawing 7 (b)). The projection mold liquid crystal panel consisted of forming the counterelectrode 11 of a polymer dispersed liquid crystal 12 and light transmission nature on this reflector 13 (drawing 7 (c)). Thus, compared with the conventional liquid crystal panel, improvement in brightness was found by making a reflector 13 into two kinds of substrate metals 131 and 133, the reflective metal 132, and a three-tiered structure.

[0026] It is not necessary to embed aluminum like an example 3 by the approach of this example at opening. Therefore, since aluminum can be formed at low temperature rather than the approach of embedding at opening, manufacture becomes simple and a reflection factor improves more again.

[0027] The example using a graphoepitaxial growth method is explained using <example 5> drawing 8 . The connection hole 14 embedded on the array substrate 18 by the thin film transistor 17, the pixel electrode 16, the insulator layer 15, and the conductive matter was formed by combining a spatter, a CVD method, the photolithography method, and the dry cleaning dirty method (drawing 8 (a)). Furthermore, the slot 20 of 50nm depth was formed in this insulator layer 15 at intervals of 1 micrometer (drawing 8 (b)). Next, after forming the aluminum-Si film of about 800nm thickness by the spatter, heating the whole substrate at 550 degrees C, the predetermined reflector pattern 13 was formed (drawing 8 (c)). In addition, some kinds of things which changed substrate temperature were created.

[0028] Thus, as shown in drawing 9 , when the amount of preferred orientation of the formed reflector was measured with the X-ray diffraction method, and the substrate temperature at the time of aluminum-Si membrane formation was 550 degrees C (111), the gap (half-value width) from the substrate side of a field was about 2 times. Moreover, when substrate temperature was 500 degrees C, 3 times, at the time of 450 degrees C, it had shifted 4 times, and the amount of preferred orientation of the metal membrane which constitutes a reflector improved, so that substrate temperature was high. However, when substrate temperature became higher than the melting point (660 degrees C) of aluminum, the inclination to react with an insulator layer 15 and for a reflection factor to fall was seen.

[0029] Thus, the place which measured the reflection factor of the formed reflector using said reflection factor measuring device (drawing 5), The substrate temperature at the time of aluminum-Si membrane formation by 500 degrees C 85% at 550 degrees C 72%, If it becomes 67% at 450 degrees C, the reflection factor of a reflector becomes high, the counterelectrode 11 of a polymer dispersed liquid crystal 12 and light transmission nature is formed on this electrode for light reflexes, so that the amount of preferred orientation of the aluminum-Si film which is a reflector is high, and a projection mold liquid crystal panel is produced Improvement in brightness was found compared with the conventional liquid crystal panel.

[0030] <Example 6> drawing 10 is the block diagram of the liquid crystal projection mold projector which used the reflective mold liquid crystal panel. The part unnecessary to explanation is omitted. The outline configuration of the liquid crystal projection mold projector of this invention is carried out with the reflective mold liquid crystal panel (21) of this invention, the light source (22), and a half mirror (23). It is reflected by the half

mirror (23) and incidence of the light injected from the light source (22) is carried out to a liquid crystal panel (21). A liquid crystal panel (21) forms the contrast according to the impressed electrical signal. That is, when liquid crystal shows light-scattering nature, the light which carried out incidence is shaded, and when liquid crystal shows light transmission nature, the light which carried out incidence from the half mirror (23) is injected from a liquid crystal panel as it is. The light injected from the liquid crystal panel (21) penetrates a half mirror (23). When this light was projected on the screen etc., it functioned as a projection mold projector. Since the polymer dispersed liquid crystal panel of this invention had a high numerical aperture, high directivity, and high brightness, improvement in contrast and brightness was found compared with the thing of the former [projector / of this invention / liquid crystal projection mold].

[0031] Although the half mirror (23) was used for optical system in this invention, the same effectiveness is acquired also by combining a lens and a mirror.

[0032] Moreover, although only a monochromatic image is obtained with the configuration of this invention, if the light source of three colors of red, green, and blue is used, it is also possible to display a color picture.

[0033] In addition, television of the other big screens of a projection mold projector etc. has [the liquid crystal panel of this invention] application more desirable than they are a high numerical aperture, high directivity, and high brightness on a projection mold display.

[0034]

[Effect of the Invention] According to this invention, since the metal side of a high reflection factor can be acquired, a liquid crystal panel with the large amount of reflected lights can be obtained.

[Translation done.]